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Animal Agriculture—Meeting Human Needs in the 21st Century

For a week in early May, more than 200 decisionmakers—scientists, public officials, consumer advocates, educators, and producers—met at Boyne Falls, Mich., to investigate how scientific research in animal agriculture can meet human needs of the 21st century.

The American Association for the Advancement of Science, the American Society of Animal Science, the American Dairy Science Association, the Poultry Science Association, the American Meat Science Association, Michigan State University, Winrock International Livestock Research and Training Center, and USDA jointly sponsored the conference.

Ten working groups examined and debated topics ranging from animal breeding to human nutrition, from food safety to marketing and distribution, to set research goals for the next century. Each group presented an outline of "research constraints and imperatives" on the last day of the conference. Their collective ideas will be published in a proceedings and executive paperback summary in September by Westview Press, 3500 Central Avenue, Boulder, CO 80301.

As a keynote speaker, Anson Bertrand, director of science and education, addressed some of the relationships of animal agriculture and research to human needs. The following comments are excerpted from his remarks:

It is the identification of human needs, or human concerns and the consideration of how we can address them, that will produce for us a strong, supportable agenda of research priorities for animal agriculture in the 21st century. Within the framework of these human needs, our livestock products will be fashioned over these next 19 years that lie between us and the year 2000.

It is also certain that these human needs will be articulated by the broad spectrum of our society—by consumers as well as by scientists; by private foundations as well as by industry; by public interest advocates as well as by public policymakers.

Animal agriculture is a crucial part of our agricultural resource base. It plays a vital role in providing quality nutrients in proportions needed by humans.

Currently, animal products provide U.S. consumers with one-third of their food energy, two-thirds of their protein, two-thirds of their fat, four-fifths of their calcium, two-thirds of their phosphorus, 38 percent of their thiamine, 79 percent of their riboflavin, 47 percent of their niacin, 60 percent of their vitamin B_6, and virtually all of their vitamin B_{12}.

Equally important, the ruminant is the key to using vast amounts of land that would otherwise go to waste as a food-producing resource—land that is too steep, too arid, or otherwise unsuitable for crop production.

To the extent that animals are fed from land unsuitable for crop production; or as part of rotations required for soil conservation; or with wastes or by-products of agricultural or industrial production, they represent a net gain to the food supplies for people. Animal production must build on this advantage, striving to become increasingly complementary to plant food production.

A diet high in animal products does require more resources to produce, and we must produce them as efficiently as possible. We must learn how to get the food to our animals at less energy cost; how to get the animal products to the consumer at less energy cost. More important, is the real need to decrease the energy used by the animal to convert feed to meat, milk, and eggs.

A major concern of consumers is the relationship between the food they eat and their long-term well-being—and this interest will continue to increase. People want to be well informed on diet/disease relationships, on the content of foods they buy and eat, and on the choices they can make.

Fat in the human diet—particularly fat of animal origin—is the subject of considerable controversy about what is known and what is not.

The recent issuance of the Dietary Guidelines by USDA and the Department of Health and Human Resources has resulted in an increasing and useful dialogue on the whole subject of nutrition. These guidelines were the result of almost 2 years of literature reviews and diet studies. However, reaching consensus among scientists in the two Departments and other authoritative scientific groups was not easy, and acceptance of the Guidelines has obviously not been unanimous.

One area of agreement, is that more research is needed on the diet/disease relationship for fat, saturated fat, and cholesterol. In the meantime, it is important to those engaged in animal agriculture to recognize that the Guidelines do *not* advise the public to eat less red meat. To the contrary, they *recommend more lean red meat.* They do *not* say eliminate saturated fat. They say *avoid too much.*

The Guidelines advise a balanced diet. Moderation. Variety. Obviously animal products hold an important place in moderate, balanced, varied diets.

We know that research can accommodate food production to nutrition needs. For example, rather great modifications can be made in fat/protein ratios in meat animals while still retaining the taste and tenderness desired by consumers.

The meat-type hog is a notable example of our success in managing fat. That research effort reduced lard content per hog carcass from 30 pounds in 1960 to about 13 pounds today, with a corresponding increase in lean meat. It is a dramatic success story in livestock research and development.

Research in beef has also shown us that genetically fast-growing animals can reach desired carcass weights at youthful ages with low-fat content and desired palatability.

(Continued on page 16.)

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Photos pp. 13 and 14 courtesy Grant Heilman.

Cover: The roof of this solar greenhouse-residence, constructed of two layers of aluminum sheeting and a layer of glass, collects heat for both home and greenhouse use. SEA engineers have designed and built the home in Clemson, S.C. Our story begins on page 4 (0480X388-5A).

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Greenhouse-Residence—
A New Place in the Sun

Imagine a family home where lettuce, cabbage, spinach, swiss chard and cucumbers are grown indoors all year round. Combining the best of both worlds, this greenhouse-residence designed in 1977 by SEA researchers in Clemson, S.C., and built there in 1978, is one practical solution to today's rapidly rising energy and food costs.

For the past 5 years, the SEA Rural Housing Research Unit at Clemson has explored developing low-cost integrated solar energy systems. The present greenhouse-residence is the third they have designed, and the fourth generation is currently being modified for improvements. Jerry Newman, agricultural engineer, is research leader of the unit, and Luther Godbey, agricultural engineer, is project coordinator.

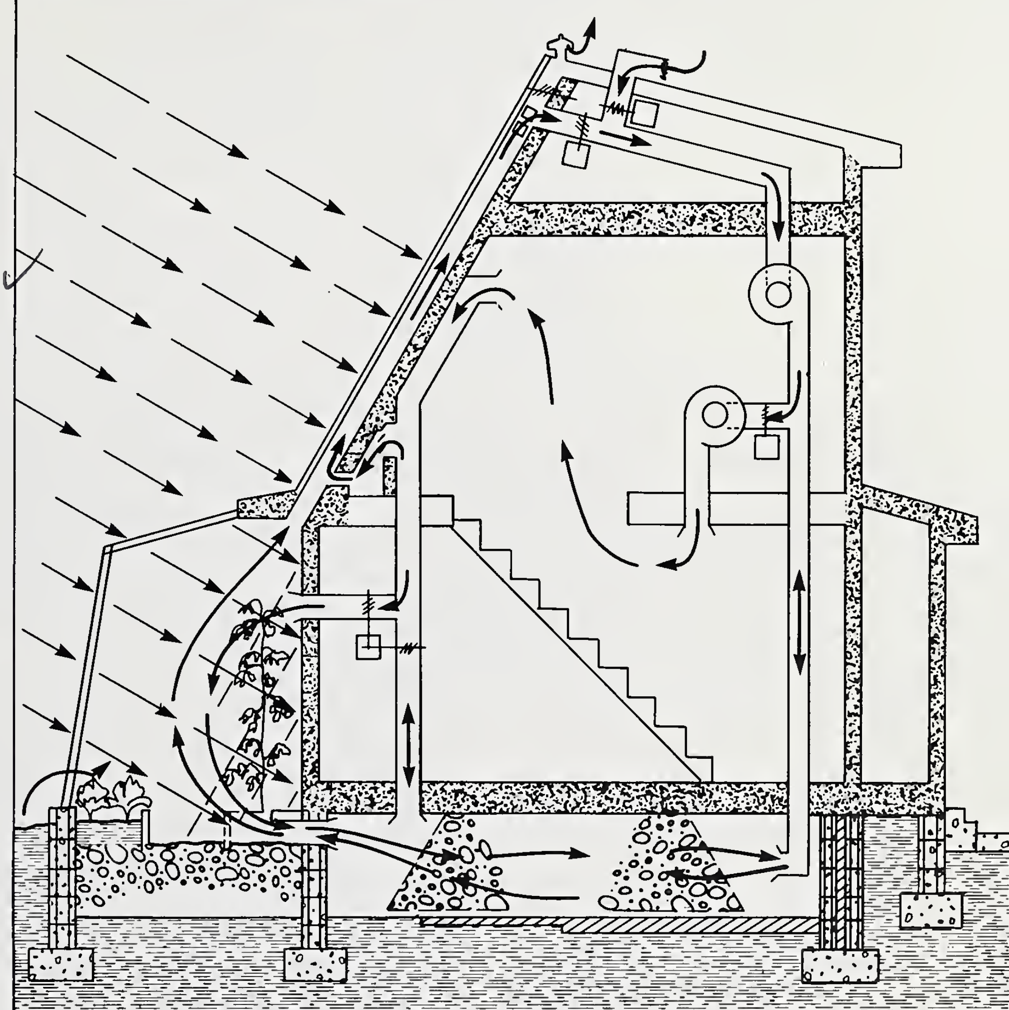
Two employees of the Clemson University research dairy farm, Bob Martin and David Davis, have lived in the present home for 20 months. The unique design of the structure combined with its utilization of solar energy enables them to conserve fossil fuel, while producing food.

Site location is critical for such a solar home. The collector, which is mounted at a 60° angle, requires the greatest amount of exposure to the sun. The south side of the home must be free of tree shading in the winter. Windows can be shaded by roof overhangs on the south in the summer. Trees are desirable on the east and west to prevent overheating of the home in the summer.

Solar energy entering the greenhouse is stored and used to help heat both the greenhouse and the residence. The greenhouse helps insulate the residence. In turn, heat escaping from the residence is used in heating the greenhouse.

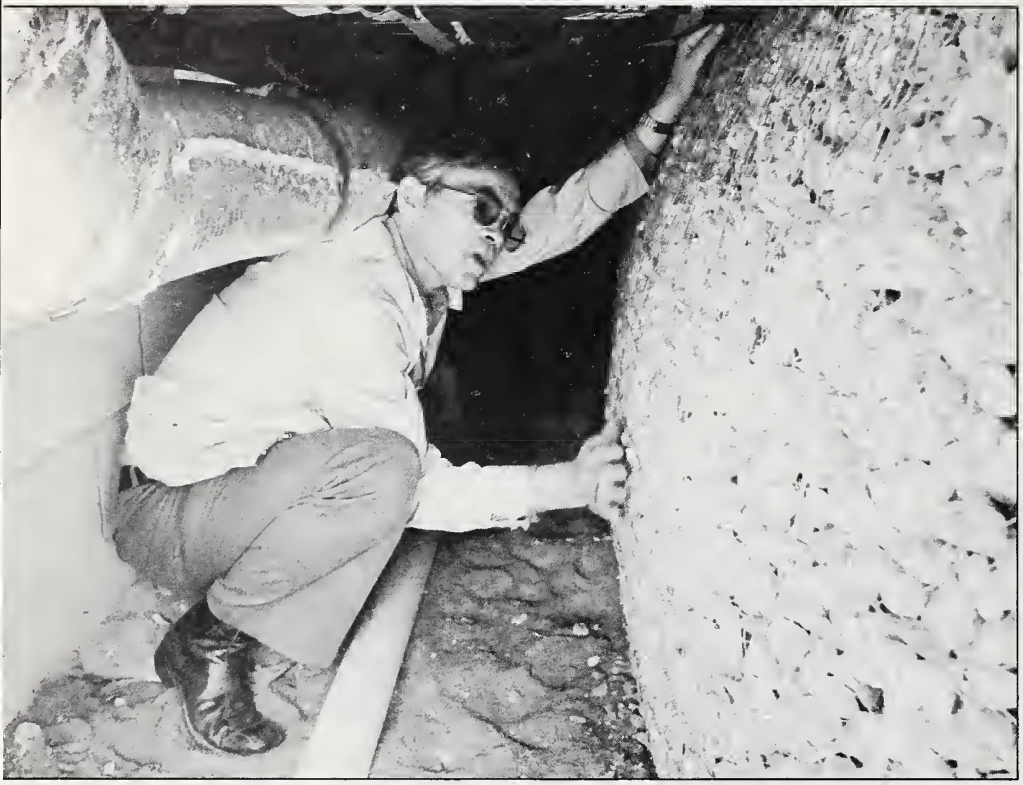
The air in the home and the greenhouse is the same. Attached to the home, the greenhouse is an integral part of the system. It operates in conjunction with a 384-square-foot flat-plate collector constructed of two

Solar Greenhouse-Residence



Solar-heated air is fanned into the greenhouse and then flows in the crushed rock for storage and reheating. From there, the air circulates through the residence and returns to the greenhouse for recycling (PN-6809).

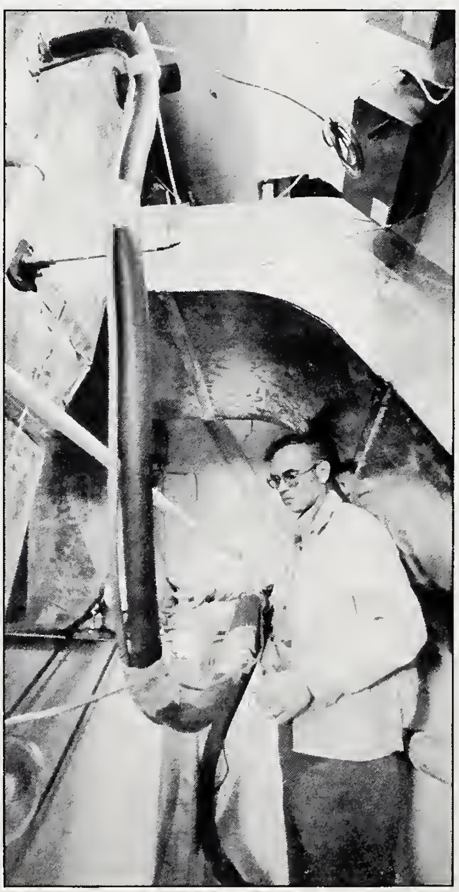
Opposite: Homeowners can grow many vegetables in this specially-designed solar greenhouse. Romaine lettuce (foreground) and swiss chard (background) flourish September through June; cherry tomatoes, cucumbers, and cabbage thrive during fall; spinach and kale burst forth in winter, and snow peas take root in spring (0480X386-30).



Above: Agricultural engineer Luther Godbey checks solar-heated air coming from 58 tons of granite stored under the residence. Warm air supplied to the residence is passed into the greenhouse and then returned to the rocks for reheating (0480X387-23).

Right: Luther Godbey inspects test equipment in the home's mechanical room. The all-electric house has an 84-gallon solar water heater supplemented by a 30-gallon auxiliary electric heater. Both are designed to accept a heat pump or oil or gas forced air (0480X385-7A).

Opposite: Bob Martin and Dave Davis, employees at the Clemson University research dairy farm, find living in the house perfect for today's energy demands. They've greatly reduced their energy and grocery bills since moving into the house 20 months ago (0480X389-17).



layers of aluminum roofing with painted interior surfaces installed as an absorber plate.

In winter, solar-heated air is drawn through the flat-plate collector and then through rock thermal storage before returning to the greenhouse.

Heated air supplied to the house, either from thermal storage or from the auxiliary heating unit, returns through the greenhouse and then back through thermal storage.

In summer, the greenhouse and collector are manually separated from the house air. Dampers and vents are opened and closed to regulate the flow of air. Vents lead from the solar collector to the outside. At night, outside air —6°F lower than the storage temperature—is used to remove the heat from the 50-cubic-yard rock storage to the outdoors through these vents. During the day, air-conditioning supplements rock storage to cool the house.

The 248-square-foot greenhouse uses a low-iron double-strength tempered glass glazing and is lined on the inside with ultraviolet-ray-resistant film. The floor is gravel. The planting beds, located on the floor, are framed in redwood.

Energy efficient, the home is built of western red cedar siding. Two stories, with 1,472 square feet of living space, it has a living room, dining room, kitchen, 1-1/2 bathrooms, study, two bedrooms, and a carport.

Windows are double-glazed and wood doors are weather stripped. Doorways have air lock entrance ways. Walls have 6-inch/R19 batt insulation and the ceiling is insulated with 12-inch/R38 fiberglass. The crawl space is insulated with 2-inch thick polystyrene.

The home is all electric with an 84-gallon solar water heater supplemented by a 30-gallon auxiliary electric heater. The system is designed to accept a heat pump or oil or gas forced air heating.

These energy conserving features and the Clemson, S.C., location are responsible for low heating costs. In

one January to April period, $164 was spent for auxiliary heating—a cost of only $41 per month.

The greenhouse may be used as a sun room by people who don't want to grow their own food. Since the greenhouse relies on returning house air for heating in the winter, cool-season vegetables are better suited for production.

Because the widespread use of insecticides in a closed environment that is part of a residence is undesirable, plants brought in should be free of insects such as aphids, while flies, and leaf miners.

Homeowners could grow half their annual vegetable needs in the greenhouse. Presently this amounts to approximately $250 worth of vegetables.

According to Newman and Godbey, most builders have the ability to build this home for approximately $65,000 to $70,000. A successful design, however, demands a high level of attention to planning and detail. A properly sealed tight-fitted collector and duct work are essential. Good quality, low leakage dampers must be installed for proper air control.

Because the greenhouse-residence is an innovation, the SEA researchers are continuing to monitor its performance by a computer and to measure the cost effectiveness of the design. They believe that the operating costs and savings in food and fuel will make such designs as this the typical home of the future.

Dr. Jerry O. Newman and Luther C. Godbey are located at the SEA Rural Housing Research Unit, P.O. Box 792, Clemson, SC 29631.—(By Eriks Likums, SEA, New Orleans, La.) 150

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Braxton—
New Soybean Variety

A new soybean variety called Braxton has been released that could increase soybean production by 10 million bushels per year.

At today's prices, Braxton's yield increase could amount to $42 million annually for the farmers of the Sunbelt States. The increased production would represent sufficient energy or calories to feed thousands of people.

SEA agronomist Kuell Hinson, who developed Braxton, based this potential on the possibility that Braxton would replace Bragg, and would compete with other varieties to be released within the next 2 or 3 years.

Another important factor is the extent to which new infestations of the soybean cyst nematode are identified in major production areas. Braxton, like the varieties Bragg, Ransom, and GaSoy 17, is susceptible to the soybean cyst nematode.

Also, a release known to be resistant to the soybean nematode and to one of the two root-knot nematode species may be available in 1980, and may influence farmers' choice of variety.

In 1966, Hinson began his research with one F_4 (fourth generation) plant selected from the cross F59-1505 and (Bragg (3) x D60-7965). The initial cross and subsequent backcrosses were made to combine high protein with high yield. Yield was achieved on a very high level, and protein level was maintained at a high rate similar to three leading varieties.

The breeding line was selected at Gainesville, Fla., in 1971 in a cooperative program between SEA and the Florida Agricultural Experiment Station. Three-year data from nine cooperating Southern states show that Braxton yielded 9, 10, and 3 percent more than Bragg, Ransom, and GaSoy 17, respectively. In addition, Braxton is resistant to two root-knot nematode species prevalent in the South.

Protein and oil percentages for the four varieties are similar. Braxton has excellent seed holding qualities, and is resistant to the foliar diseases target spot, bacterial pustule, frogeye leafspot, and powdery mildew. It also has field resistance to phytophthora rot.

"Braxton has the potential to replace Bragg in most if not all of the areas where that variety is now grown," says Hinson. "This will occur gradually over a period of several years. Peak utilization probably will not occur until near the middle of the next decade."

Braxton was released cooperatively by SEA and 8 Southern experiment stations. Breeder seed of Braxton, produced at Gainesville, Fla., and Stoneville, Miss., was distributed to seed-producing organizations in Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, and South Carolina.

Dr. Kuell Hinson, SEA agronomist, is stationed on the University of Florida campus, Department of Agronomy, Room 10, Newell Hall, Gainesville, FL 32611.—(By Peggy Goodin, SEA, New Orleans, La.)

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Brown Stem
Rot Resistance [1,2]

"We have cultivated [soybeans] continuously, or too frequently, over an extended period of time without adequate rotation or disease preventive practices," says Hideo Tachibana.

Tachibana, a SEA plant pathologist stationed at Iowa State University, Ames, says that as a result brown stem rot (BSR) is caused by the fungus *Phialophora gregata*.

Tachibana began working on development of a soybean with resistance to BSR in 1970. He predicted that BSR, a recognized disease problem in southern Iowa, would also become a problem in northern Iowa as soybean acreage increased there.

In 1973, Tachibana cooperated with five Iowa soybean growers with BSR problems: Karl A. Kirk, Ames; Donald W. Whitecotton, Bagley; H. Dean Hanks, Huxley; Harold D. Witzenburg, Otley; and Jerry D. Kincart, Bloomfield.

The growers planted strips of low-yielding, BSR-resistant soybeans and strips of commercial varieties. The BSR-resistant lines produced higher yields and had less disease damage in the areas with a history of high BSR infestations.

Tachibana continued to develop resistant lines for both northern and southern Iowa, improving the yield potential as well as the disease resistance.

Soybean disease surveys in 1966 and 1972 showed BSR to be most common in the south central and southeastern areas where 79 percent of the fields were infested. It was not then considered to be a serious problem in northern Iowa.

Tachibana, nonetheless, worked on breeding BSR-resistant soybeans for northern as well as southern Iowa. He believed the disease would spread northward as soybeans became more popular and acreage planted increased.

He says the organism seems to thrive when plants are under moisture stress. Northwestern and north central Iowa normally receive less rain than central and southern Iowa.

Explaining how BSR damages

Soybean harvest near Stoneville, Mississippi (1176X1501-16).

plants, Tachibana compares brown stem rot with vascular disease problems in people.

"Man can get along well with hardened vascular tissues as long as he is not under stress. But, under stress, a restricted circulatory system increases chances of serious problems such as heart attacks. Brown stem rot fungus similarly affects the vascular tissues in plants and predisposes soybean plants to stress conditions such as lack of moisture. The consequence is yield reduction," Tachibana says.

In 1977, Tachibana enlisted the help of A. H. Epstein, plant pathologist with Iowa's Cooperative Extension Service, to find out how serious BSR was in northern Iowa. They worked out a comprehensive BSR survey of soybeans in northern Iowa.

Extension staff collected specimens in 31 northern counties.

Tachibana and other SEA researchers picked up the samples from the county offices and brought them back to Ames for examination.

The results showed that 94.5 percent —274 of the 290 fields sampled—were infested with BSR. In northwestern Iowa, 97.5 percent of the sampled fields were infested; 98.4 percent in north central; and 76.6 percent in northeastern counties.

Samples were obtained in the three areas between September 1 and 10. That is usually the peak period for BSR, Tachibana says. Sampling locations were preselected at random several months before field collections were made.

Ten plants were selected from three locations in each field sampled. One sample was taken from the third row in from the border, and the other two samples away from border rows of the field. Results showed less BSR in plants from the border samples than in plants from the interior.

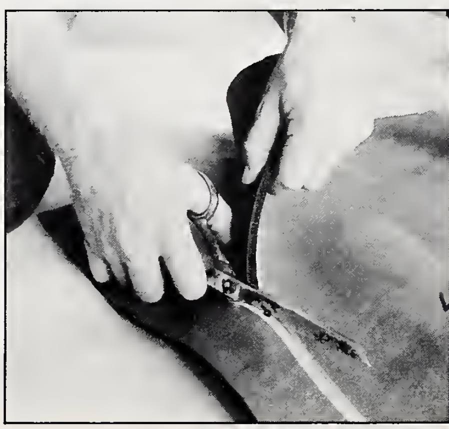
"The cooperation of the Extension Service made possible a survey otherwise impossible with the available research funds and personnel," Tachibana says.

Two BSR resistant germplasm lines, developed by Tachibana in cooperation with the Iowa Agricultural Experiment Station, numbered A3 and A4, were released to soybean breeders in 1978. A3 is adapted for northern Iowa, and A4 is adapted for the southern areas of the state. The first variety—BSR 301 —will be available to growers in 1981, Tachibana says.

Dr. Hideo Tachibana is located at the Department of Botany and Plant Pathology, Iowa State University, IA 50011. —(By Ray Pierce, SEA, Peoria, Ill.)

Stock Pond Covers Reduce Evaporation

Above: Allen Dedrick (foreground) and Mark Nolte, Bureau of Land Management, glue and lap the rubber sheeting together to form the stock pond covers (1079X1401-5).



Right: Stock pond covers are made from low-density, closed-cell synthetic sponge rubber weighing about a pound per 6 square feet for ¼-inch thick sheeting (1079X1401-26).

Farmers and ranchers in areas of high evaporation could reduce water losses from stock tanks by 80 to 90 percent by using floating sheets of foam rubber.

Spots around Needles, Calif., lose about 7 feet of water to evaporation each year from ponds, lakes, and stock water tanks. In the other 17 Western states, the sun takes from 2 to 6 feet of water—several times the annual precipitation in many of the areas.

Water hauling costs in the more remote regions run from $10 to $30 per 1,000 gallons. Cost of water saved by the covers, depending upon the evaporation rate, varies from about 75 cents to $4 per 1,000 gallons.

"In remote areas where water expense is high—hauling, harvesting, pumping, piping over long distances—an operator will want to save as much water as possible," says Allen R. Dedrick, SEA agricultural engineer at Phoenix, who has evaluated the floating covers over a period of time.

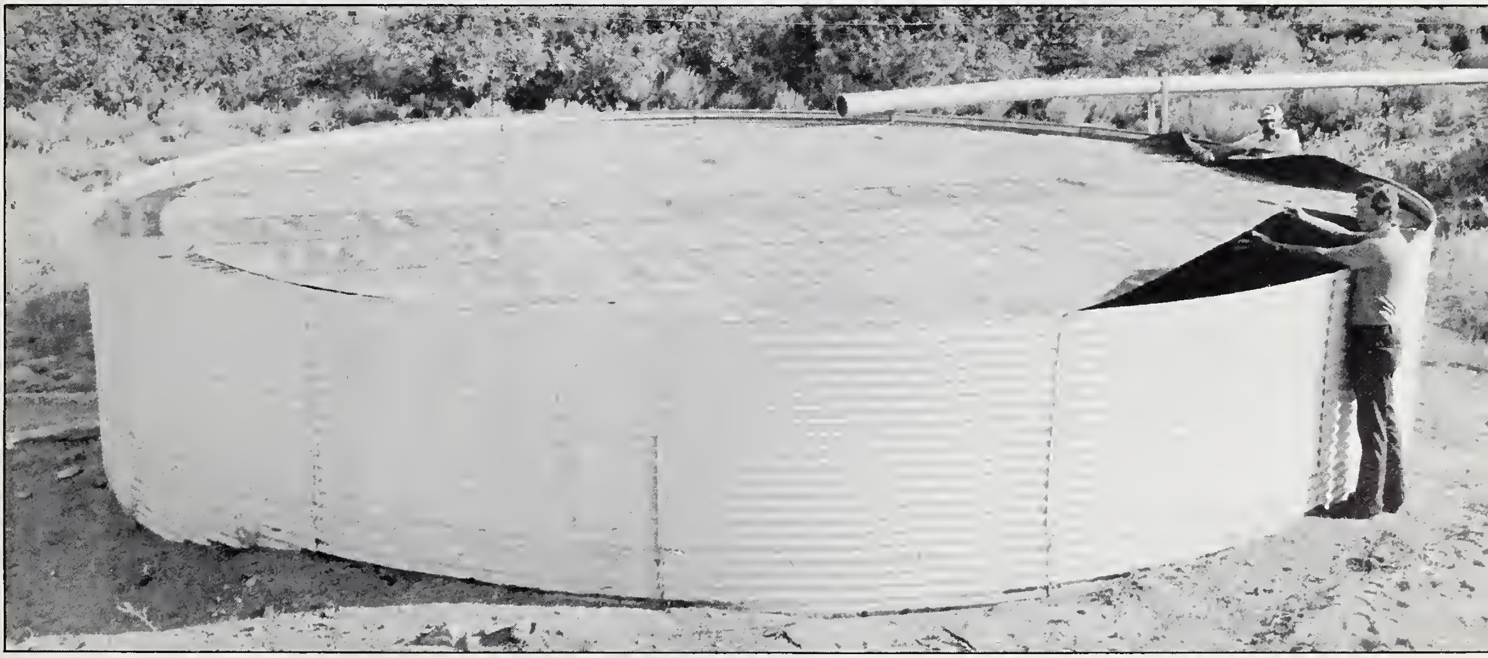
Dedrick makes the covers from low-density, closed-cell synthetic sponge rubber weighing about a pound per 6 square feet of ¼-inch thick sheeting. It comes in various roll widths up to 4 feet and costs about 30 cents per square foot. The 4-foot width is the most practical size.

Covers are assembled on a hard, flat surface. The sheeting is lapped and glued together to form the cover sized to fit inside the tank. Two men can assemble a 30-foot diameter cover using 4-foot wide sheeting in about 3 hours.

The covers are expected to last at least 10 years. The oldest cover was installed on a tank near St. George, Utah, in 1971.

The Forest Service, Bureau of Reclamation, and the Bureau of Indian Affairs are among the many other agencies making use of the covers.

Detailed instructions for making the covers can be obtained by writing to Dr. Allen R. Dedrick, U.S. Water Conservation Laboratory, 4331 East Broadway Road, Phoenix, AZ 85040.—(By Paul Dean, SEA, Oakland, Calif.)



Top: This cover is being unfolded onto the water's surface. Puncture holes in the cover allow rain water to enter the tank and prevent the cover from sinking. This particular water tank has holes around its rim that allow excess water to seep out (1079X1404-20).

Above: Dedrick and Bob Brown (background), Bureau of Land Management, finish the cover installation. The cover fits close to—but not flush against—tank walls to allow for easy flotation. The inflow pipe above the tank collects storm runoff from a water harvesting catchment (1079X1403-11).

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Worms? No, Spiroplasmas! [ ]

When SEA plant pathologist Robert E. Davis discovered in 1972 the agent that causes corn stunt disease, he opened a whole new can of worm-like microbes.

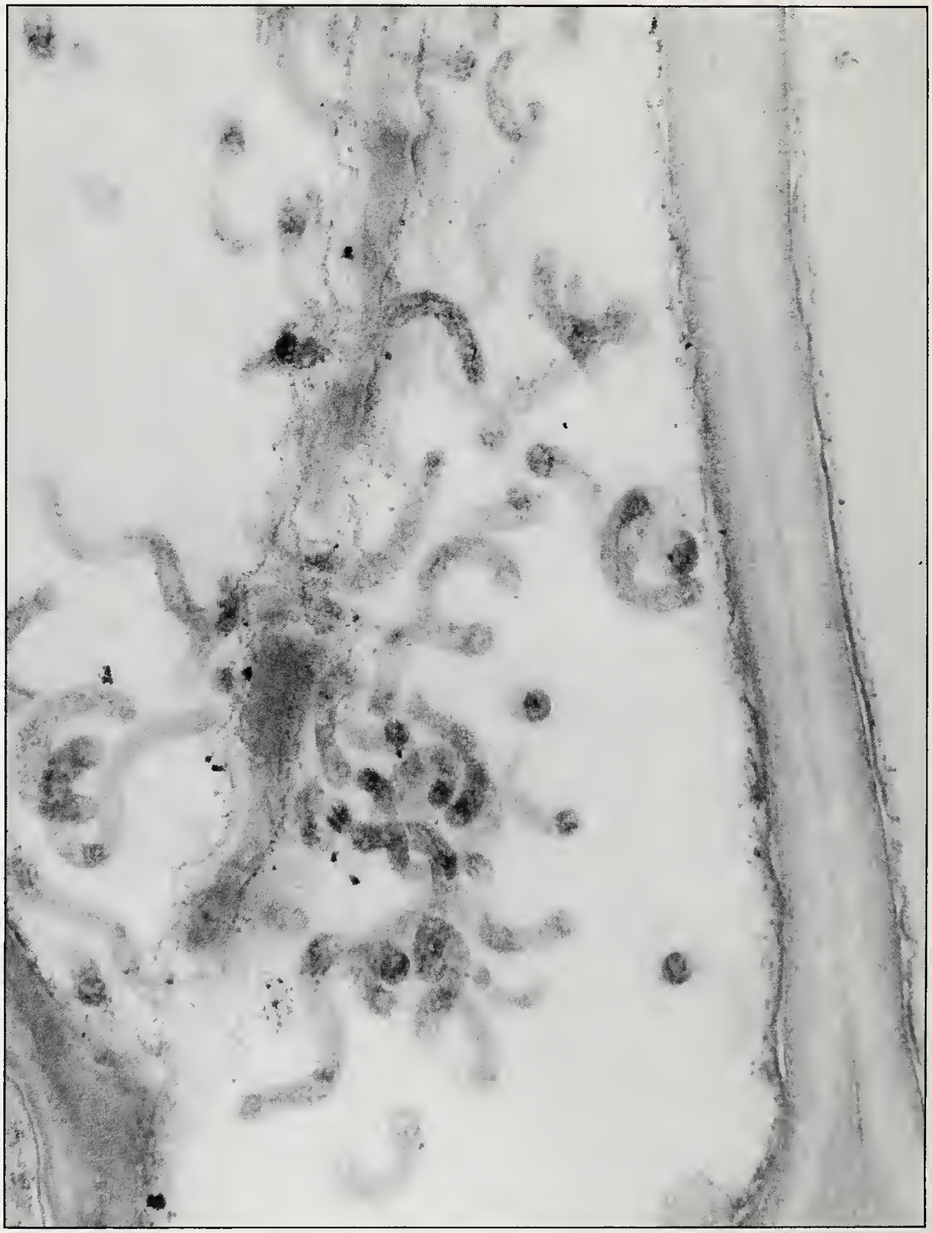
Since then, these spiral-shaped, primitive organisms—unlike bacteria, spiroplasmas have no cell walls—have been found in diseased plants other than corn, and in healthy and diseased insects. They have also been found on the surfaces of flowers of healthy plants (presumably in nectar). Others, from ticks, have been found to cause a disease when introduced into vertebrate animals in laboratory tests.

Davis and colleagues at the Beltsville Agricultural Research Center in Maryland have classified several plant and arthropod-borne spiroplasmas into groups and subgroups on the basis of membrane antigens, and suggest that several species are represented. A visiting scientist working with Davis in the Plant Virology Laboratory, I.-M. Lee, has confirmed Davis' classification by comparing the similarities and differences in the spiroplasma chromosomes.

While serological techniques have been useful in grouping the spiroplasmas for identification and taxonomy, Davis sees their potential importance in "improving the diagnosis of spiroplasma-caused diseases."

After serological techniques are further refined, they can be used to determine if spiroplasmas are present, not only in plants or insects obviously diseased, but also in plants or insects that do not show disease symptoms. This will also allow researchers to study the distribution of these microbes in different plant and insect species, and to learn which insects carry them from plant to plant.

Among the plant spiroplasmas, two are definitely known to cause diseases —[corn stunt and stubborn disease of citrus trees] The citrus spiroplasma also infects broccoli, turnip, radish, cabbage, and other crops. Other spiroplasmas are suspected of causing "yellows diseases" in lettuce and Bermudagrass.



Worm-like spiroplasmas—magnified 25,000 times—in corn stunt-infected tissue are shown in an electron micrograph taken by Beltsville scientist Russell L. Steere. These spiral-shaped, primitive organisms have been found to cause plant and insect diseases (PN-6808).

Spiroplasmas which have been found in flower nectar appear harmless to the plants they are found on—presumably left and picked up there by honey bees and other nectar-feeding insects in which they may cause disease. At least one spiroplasma, discovered in honey bees by Beltsville research entomologist Truman B. Clark, causes a serious disease in bees.

Dr. Robert E. Davis is located in Room 235, Bldg. 011A, Beltsville Agricultural Research Center, SEA-AR, Beltsville, MD 20705.—(By Judy McBride, SEA Beltsville, Md.)

Date Palm Trees Cloned

A tissue culture technique used to clone date palm trees holds promise as a method to save years in increasing date tree populations.

Tissue culture has long been used in the study of human disease—Jonas Salk used it to develop the polio vaccine. It is a process of growing living tissues and cells artificially in special, sterile, culture mediums. Some plants—palm trees among them—lend themselves more easily than others to the technique.

Trees for new orchards or replacements for old, damaged, or dead trees come from offshoots or "suckers" from desirable trees. These desirable trees produce only a few offshoots during their lifetime. Competition for the offshoots available in California's Coachella Valley is spirited because of the excellent quality of the dates. Also, the valley is free of most date diseases.

Bidding for these offshoots comes from Israel and other date producing countries. Cost of the plants, by the time they reached overseas outlets, runs from $50 to $60 per plant.

If this technique is commercialized, plants produced from tissue culture should not only lower the cost of palms, but also make many thousands of plants available within 6 to 10 years, says Brent Tisserat, SEA plant geneticist, Indio, Calif.

Since the principal date palm varieties in the United States and overseas are hundreds of years old, chances are not too many new varieties will be introduced. If the need to develop certain disease-resistant varieties or varieties more responsive to improved harvesting arises, the tissue culture technique could cut as much as 25 years from the time it takes to increase a new variety by offshoots to 5,000 plants, or about 100 acres of date orchard.

Each individual plant or animal cell contains all the genetic information needed to duplicate the complete "individual" under the right conditions.

Tisserat has been cloning date palm trees for the past year and is growing them in the greenhouse for transplanting later to the field.

Dates ripen under a warm California sun.

He obtained his clonal material from offshoots of 5-year-old seedling palms and placed the material in the culture solution. In that medium, the material grows into a mass called callus. Shortly, a portion of the callus begins to form roots, stems, and leaves that can be transplanted as whole plants. Each callus bundle, Tisserat says, can be cultured to produce hundreds of clones, all exactly alike and duplicates of the original tree.

Before completing this research, Tisserat will attempt to develop an "assembly line" method to mass produce the plants to cut costs and make the method practical for date growers in this and other countries. Dates are a $16 million industry in this country.

Dr. Brent Tisserat is stationed at the U.S. Date and Citrus Station, 44-455 Clinton St., Indio, CA 92201.—(By Paul Dean, SEA, Oakland, Calif.)

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Fighting Flu in Turkey Flocks

Type A influenza viruses that victimize people also attack pigs, horses, and poultry. During the winter of 1978-79 in Minnesota, turkeys experienced the most costly influenza outbreak in the state's history. Losses in the millions of dollars were reported with more than a hundred flocks of market turkeys and 11 breeding flocks affected.

The source of avian influenza virus infections in poultry is not clearly known, but migrating waterfowl may play a central role in introducing the disease.

Research at the SEA Southeast Poultry Research Laboratory in Athens, Ga., indicates that control of virulent avian influenza virus in chickens and turkeys may be feasible by vaccinating poultry with inactivated vaccines.

Well before the Minnesota outbreak, SEA scientists at the Athens lab were concerned that the disease could result in severe and even disastrous poultry losses—especially since there are 9 antigenically distinct avian influenza viruses affecting members of the avian or bird family. A prior infection or a vaccine prepared with one antigenic subtype does not protect against disease caused by any of the other 8 subtypes.

Veterinarians Max Brugh, Charles W. Beard, and Henry D. Stone studied a single vaccine that could contain antigens of up to 4 subtypes. This single vaccine was necessary because it is currently impossible to predict the virus subtype that will cause problems during a particular winter, say the scientists.

Chickens and turkeys vaccinated with inactivated virus in oil-emulsion vaccines—containing different concentrations of either 1 (monovalent) or 4 (polyvalent) strains of avian influenza virus—were exposed to lethal A/chicken/Scotland/59 or A/turkey/Ontario/7732/66 influenza viruses. Vaccines that contained enough antigen completely protected poultry against death after exposure to the lethal influenza viruses.

Vaccine valency did not alter the serologic and resistance responses of chickens vaccinated with A/turkey/Wisconsin/68, which was the virus component common to both monovalent and polyvalent vaccines. The extent of the serologic responses and protection against exposure with lethal viruses depended on the concentration of virus in the vaccines.

As soon as the scientists completed their experiments and tabulated their results, the Minnesota turkeys experienced the costly epidemic. Although 4 different subtypes of influenza virus were active in the area, most losses were due to 2 antigenic subtypes.

News of the successful experimental multi-component vaccine resulted in an emergency exemption to the usual vaccine licensing procedure. The poultry industry hired a commercial poultry vaccine company to make a bivalent vaccine containing the 2 subtypes. Company employees consulted with SEA scientists in preparing the new vaccine.

Serologic tests show that the immunization program was indeed successful, but the true test will be in the turkey house during this year's influenza season, say the scientists.

Dr. Max Brugh, Dr. Charles W. Beard, and Dr. Henry D. Stone are located at the SEA Southeast Poultry Research Laboratory, 934 College Station Road, Athens, GA 30605.—(By Peggy Goodin, SEA, New Orleans, La.)

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Rangeland Water Harvesting

Ranchers or researchers converting rangeland from brush to grass to increase the range's usefulness in feeding livestock or wildlife are faced with another problem once the forage has become established—water.

Runoff from rain or snow on successfully converted ranges is dramatically reduced and the usefulness of any existing stock ponds that depended upon that runoff is reduced as well.

The alternative is water harvesting, says SEA hydraulic engineer Gary W. Frasier of Tucson, Ariz.

Water harvesting is a technique for making soil surfaces on mini-watersheds water repellent with the use of certain chemicals. Water as rain or snow falling on those small areas is channeled into tanks or ponds for use by livestock or wildlife in semiarid environments like Arizona.

Frasier converted a site in southern Arizona from a brush covered plant "community" to a grass covered one by tearing out the brush with a root plow and then reseeding with grass.

The practice increased the livestock carrying capacity of the site from 1 cow to 8 to 15 cows per square kilometer (256 acres).

The researchers anticipated the decline in runoff. Therefore they built a water harvesting catchment of about 800 square meters (1,000 sq. yds.) that "harvested" about 5,600 gallons of water for each 6 inches of precipitation. By going into a grazing system with a full tank of water (around 5,000 gallons), a satisfactory water supply was available when an additional 6 inches of precipitation fell during the grazing period. With larger storage, this particular catchment could supply water to all the livestock immediately outside the test area as well, Frasier says.

Without the harvested water, the increased forage on the renovated land could not be used as efficiently without costly water hauling, long pipelines, or wells.

There are about 275 million acres in the western United States classified as pasture or rangeland. Some 77 million acres of that land is classified as good. The rest is considered substandard. In many areas, misuse has permitted brush to invade previously good grasslands. Developing methods for restoring such areas back to grass is part of SEA's research effort.

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Animal Agriculture— Meeting Human Needs in the 21st Century

(Continued from page 2.)

There is also much more that can be done by going to the cellular level and building our understanding from there. We need to know the rates, amounts, and efficiencies of lean and fat tissue deposition . . . in terms of muscle-fiber number and size, and in terms of fat-cell number and size. With this basic understanding we can probably improve the rate of growth and efficiency of growth of our meat animals as well as optimize the lean-to-fat ratio.

We have a long way to go in terms of gaining this basic understanding. At this time, we cannot even identify the *precursor* of the fat cell.

Fat is also an *economic* problem. Use of animal fat is a difficult problem in much of the world. For example, recent efforts to negotiate a science and technology agreement with the Japanese ran into difficulty with regard to joint work on animal fat utilization.

The abdominal fat in broiler chickens, for example, accounts today for 3.5 percent of the chicken's live weight. This is fat that is largely discarded. If poultry breeders could cut that abdominal fat to 1 percent of the chicken's live weight, we could save an estimated $177 million a year. The money could be saved all along the line . . . by the processor . . . the retailer . . . the consumer.

If consumers are increasingly interested in the nutritional aspects of their food, they are doubly concerned about the safety and quality of their food supply. Research in this area often has an urgency attached to it. At the same time, this research can be very frustrating because of the complexity of the problems and the many and often conflicting interests involved.

The list of researchable problems in food safety is a long one. Certainly we need fast, positive methodology to detect undesirable materials in animal products, whether by natural toxicants or by production practices, or inadvertently introduced by packaging materials or other environmental factors.

We need improved monitoring technology that will make it possible to identify the source of the problem and to track the success of measures taken to alleviate it. The success we are having with sulfonamides in pork is an example. Research can be profitably aimed at helping improve regulatory actions or make them unnecessary by eliminating the problems they are designed to control.

Innovation is needed not only in the regulatory area, but throughout our food system. Much of the current technology was developed in an era of cheap energy. It has been 50 years since frozen foods were introduced to the American people in retail packages. Eighteen cuts of frozen meats were among the 26 items that went on display in 10 grocery stores in Springfield, Massachusetts, in March of 1930. No truly new preservation method has been developed and commercialized since that time.

We need new methods that will increase shelf-life and storage stability without requiring large energy inputs.

One key to new technology may be the control of microorganisms present on meat and in meat products by the use of methods that are known to hold promise, but are not now in practice.

For example, the surface pasteurization of meat is feasible by the use of ionizing radiation. Although seemingly expensive, the scaling-up of this procedure might possibly prove to be cost-saving in the long term. Certainly if sterilization could be achieved by the use of this type of radiation or by other new technology, and the dependence on chilling or freezing reduced or eliminated, world trade of meat could be greatly increased.

The problem presented to researchers is how to accomplish this without compromising all the attractive features of meat as a food—its aroma, flavor, texture, and nutritional value.

NEXT MONTH: Land and water resources and productivity as they relate to animal agriculture in the 21st century.